a1 cont'd. surfaces coated with a protective coating sufficient to inhibit flaking of the particles of graphite.

Sub B2 10. A process for producing a thermal interface having protective coating sufficient to inhibit flaking of the particles of graphite, the process comprising (a) forming a flexible graphite sheet into the size and shape desired for a thermal interface, wherein the formed flexible graphite sheet has at least one major surface and at least one edge surface, and wherein the sheet has its directions of greater thermal conductivity parallel to the major surface; and (b) coating the formed flexible graphite sheet with a material to form a protective coating, such that the material forms a protective boundary about the flexible graphite sheet.

A2

<u>MARKED UP VERSION OF THE CLAIMS</u>

1. (Amended) An isolated thermal interface comprising a flexible graphite sheet <u>including particles of graphite, the sheet</u> having two major surfaces, at least one of the major surfaces coated with a protective coating sufficient to inhibit flaking of the particles of graphite.

10. (Amended) A process for producing a thermal interface having protective coating sufficient to inhibit flaking of the particles of graphite, the process comprising (a) forming a flexible graphite sheet into the size and shape desired for a thermal interface, wherein the formed flexible graphite sheet has at least one major surface and at least one edge surface<u>, and wherein the sheet has its directions of greater</u>

thermal conductivity parallel to the major surface; and (b) coating the formed flexible graphite sheet with a material to form a protective coating, such that the material forms a protective boundary about the flexible graphite sheet.

COMMENTS

THE INFORMATION DISCLOSURE STATEMENT

The Examiner had objected to the previously filed information disclosure statement on the ground that no copy of International Publication No. WO 99/35196 is in the file. A copy of that reference is being enclosed herewith.

THE 112 REJECTIONS

The Examiner had rejected claim 1 under 35 U.S.C. §112 on the grounds that there was insufficient antecedent basis for the phrase "the particles of graphite". Claim 1 has been amended to cure this problem.

PARAGRAPH 4 OF THE OFFICE ACTION

In paragraph 4 of the Office Action the Examiner has rejected claims 1-3, 5, 7 and 8 under 35 U.S.C. §102 based upon U.S. Patent No. 6,075,287 to Ingraham *et al.* That rejection is respectfully traversed for the following reasons.

Claim 1 is directed to an "isolated thermal interface". The thermal interface is a very thin sheet of material which fits between the electrical device and a heat sink. Such a thermal interface may be used in place of conventional thermal greases or adhesives which are commonly used to connect the electrical device to the heat sink.

The Ingraham *et al.* reference discloses nothing of relevance other than the conventional use of adhesives or thermal greases as an interface between its electrical device 14 and its heat sinks 12 or 12A. The interfaces of Ingraham *et al.* are the layers 15 and 16.

The Examiner has tried to analogize Ingraham's heat sinks 12 and 12A to the thermal interface of claim 1, apparently because both are made of graphite. But that is simply inappropriate. The members 12 and 12A of Ingraham *et al.* are not thermal interfaces. They are heat sinks.

The purpose of the present invention, which provides an isolated thermal interface, is to prevent graphite flakes from the interface to flake off and interfere with the performance of the electronic device which physically engages the interface. That is not an issue with regard to the graphite heat sinks 12 and 12A of Ingraham *et al.*, since they are not engaged with the electronic device 14.

With regard to claim 2, the protective coating is required to be a thermoplastic material. The Examiner has referred to the language at column 5 line 31, however it is noted that the language at column 5 line 31 is not describing Ingraham's interface layers 15 or 16 but instead is describing a cylindrical insulator 28 which surrounds an electrical connection 30 extending through the thickness of the heat sink 12A. There is no suggestion in Ingraham *et al.* of the use of a thermoplastic material in place of or surrounding the adhesive or thermal grease layer 16 or 15, respectively. The same is true of the Examiner's comments regarding claim 3 which requires that the thermoplastic comprise a polyimide.

Claim 5 requires that the protective coating around the thermal interface be "effective to electrically isolate the coated major surface of the sheet of flexible graphite particles". The language referred to by the Examiner, however, is referring to a coating on the heat sink 12A, not on the interface layer 15. The interface layer 15 is itself of course non electrically conducting and there is no reason to "isolate" Ingraham's interface layers 15 or 16.

Claim 7 further requires a layer of adhesive interposed between the protective coating and the flexible graphite sheet which makes up the thermal interface. This time the Examiner refers to column 5 lines 30-35 of Ingraham apparently for its mention that the material used for the cylindrical insulator 28 may be in a solid sheet or insert material applied adhesively. That begs the question that Ingraham *et al.* does not show or suggest the use of such a coating or adhesive on a thermal interface between an electrical component and a heat sink.

Finally, with regard to claim 8 which requires that the adhesive be selected from the group consisting of acrylic and latex materials, the Examiner refers to column 5 line 32 of Ingraham *et al.* With respect, it is not seen where there is any discussion there of acrylic or latex materials utilized as an adhesive. Furthermore, as noted with regard to claim 7, this entire discussion which the Examiner has referenced at Ingraham *et al.* has nothing to do with an isolating coating on a thermal interface. Instead, it deals with an electrical insulator 28 placed about an electrical conductor 30 which connects two electrical devices. Ingraham *et al.* essentially provides coated wires extending through its heat sink 12A to connect electrical devices on opposite sides of the heat sink. This has absolutely nothing to do with the issue of

utilizing a flexible graphite sheet as a thermal interface between an electrical device and a heat sink, and the need to coat that flexible graphite sheet in order to prevent graphite flakes from contaminating the electrical device.

Accordingly, it is respectfully submitted that the 35 U.S.C. §102 rejection based upon Ingraham *et al.* is inappropriate and should be withdrawn.

PARAGRAPH 5 OF THE OFFICE ACTION

The Examiner has rejected claim 10 under 35 U.S.C. §102 based upon U.S. Patent No. 5,834,337 to Unger *et al.*

The graphite material disclosed in Unger *et al.* is not a "flexible graphite sheet" as that term is used in the present application. As described in the present application at page 7 line 24-page 8 line 7 and page 4 line 27-page 6 line 2, a flexible graphite sheet has a high electrical and thermal conductivity along the plane of the sheet and a very much lower relative electrical and thermal conductivity through the thickness of the sheet. This is just the opposite of the material described in Unger *et al.* which instead of being a flexible graphite sheet is a composite of resin and graphite fibers wherein the graphite fibers are oriented across the thickness of the material instead of within the plane of the material.

Claim 10 has been amended to specify that the flexible graphite sheet "has its directions of greater thermal conductivity parallel to the major surface."

With this amendment, the Unger reference is clearly distinguished.

PARAGRAPH 7 OF THE OFFICE ACTION

The Examiner has rejected claims 4, 6 and 9 under 35 U.S.C. §103 based upon Ingraham *et al.* in view of Unger.

With regard to claims 4 and 9 which specify maximum thicknesses of the protective coating, the Examiner has not provided any prior art basis for his rejection but instead has merely speculated that it would have been obvious to modify the coating to make it thinner because that would maximize the thermal conductivity.

With respect, the Examiner's speculation is misplaced. The use of a thin plastic protective covering such as that of claim 4 would not even be attempted by persons of ordinary skill in the art. The handling and bonding of extremely thin (less than 0.025 mm) plastic sheets is very difficult. The ultra-thin plastic also must be applied to maintain the smooth surface of the interface without wrinkling so as to maintain the best thermal contact. Thus claims which provide for the use of a very thin plastic are not in any way suggested by the Examiner's speculation or the cited references.

With regard to claim 9, that claim is directed to the thickness of the layer of adhesive which is required to be no more than about 0.015 mm in thickness. Apparently the Examiner has just thrown this in with his discussion of thin protective coatings, and the Examiner has provided absolutely no explanation as to why it would be obvious to have an ultra-thin adhesive layer between the interface and the protective coating.

With regard to claim 6, which requires that the flexible graphite sheet comprising the thermal interface have an edge surface with at least one edge surface being coated with a protective coating sufficient to inhibit flaking of the particles of

graphite, the Examiner has for some reason segued into a discussion of pencil lead. With respect, it appears that the Examiner is confusing the terms "exfoliated graphite" (which applicants used to refer to chemically modified, thermally expanded, recompressed natural graphite-based flexible sheet) with the laminar characteristic of all graphite material in general. The graphite used in pencils is typically a combination of graphite with a binder; the use of these materials for writing is due to the laminar characteristics of graphite. Because of the binder, pencil graphites do not flake or generate particles except during the application of pressure and shear forces in writing. The use of graphite for writing would not lead one to expect a need to coat the graphite heat sink of Ingraham, since there are no shear forces involved in the Ingraham structure.

PARAGRAPH 8 OF THE OFFICE ACTION

The Examiner has rejected claims 12, 14, 17 and 20 under 35 U.S.C. §103 based upon Unger.

With respect to claim 12, which requires that the protective coating be coated on the formed flexible graphite sheet by spray coating, roller coating or hot laminating press, the Examiner has simply speculated that such application methods are well known. What the Examiner is overlooking, is that the combination of a flexible graphite sheet thermal interface with a protective coating is itself unknown and is not a trivial combination to make even when one suggests that the same would be desirable. This is especially true when using the ultra-thin plastic coatings as described in the invention. Thus, for example, one of ordinary skill in the art of

flexible graphite would not even consider a process like hot laminating pressing of thin plastic sheets.

With regard to claim 14 which requires that the material be coated by one of a selected number of processes and then cut into the desired size and shape, the Examiner again speculates that various coating processes are known and that it would merely be a change in the order of Unger's steps to first coat then cut.

With respect, this is pure unsubstantiated speculation and hindsight. As previously noted, Unger is not directed to a coating on a flexible graphite sheet in the first place. Unger's material is formed not from a flexible graphite sheet, but instead as described at column 3 line 65-column 4 line 2, "the alignment of the carbon fibers is achieved by applying pressure to the resin/fiber compound while still in its formable state which causes the fibers to align in a direction generally perpendicular to the direction of pressure during cure." Thus Unger is never cut in the first place but instead is molded. It would be impossible to first coat Unger and then mold it. Instead, Unger's device must first be molded and only then can it be coated.

With regard to claims 17 and 20 which deal with the maximum thicknesses of the coating material and the adhesive layer, which are analogous to claims 4 and 9, discussed above, see the arguments above with regard to claims 4 and 9. Furthermore, it is noted that the coatings utilized in Unger are all thermally conductive materials and thus the Examiner's suggestion that it would be obvious from Unger to make his coatings thinner is completely misplaced.

PARAGRAPH 9 OF THE OFFICE ACTION

The Examiner has rejected claims 11 and 13 under 35 U.S.C. §103 based upon Unger and further in view of U.S. Patent No. 5,650,592 to Cheskis *et al.*

The Examiner is apparently citing Cheskis to try to provide some support for rejection of those claims such as claim 11 which requires that the coating flow around at least one edge surface. With respect, Cheskis *et al.* shows nothing more than that articles can be completely coated. The article 12 of Cheskis is not a flexible graphite sheet. The article 12 of Cheskis is not a thermal interface. The coating 22 of Cheskis is a thermally conductive coating which is described as a "metallic layer".

The article 12 of Cheskis does not include particles of graphite which can flake, but instead as shown in Fig. 2 of Cheskis its article 12 is made up of spheroids of graphite in a molten metal matrix 20.

Cheskis does not disclose a flexible graphite sheet of any kind, and thus Cheskis does not disclose a flexible graphite sheet having at least one major surface and at least one edge surface. Cheskis simply does not deal with the same problem as the present invention.

PARAGRAPH 10 OF THE OFFICE ACTION

Finally, in paragraph 10 of the Office Action, the Examiner rejects claims 15, 16, 18 and 19 under 35 U.S.C. §103 based upon Unger *et al.* in view of Ingraham *et al.*

First it is noted that these claims are dependent from claim 10 and thus should be allowed for the same reasons as given for claim 10 above.

Furthermore, it is noted that Ingraham does not disclose the use of a thermoplastic material for coating a thermal interface, but instead the only disclosure of a thermoplastic material in Ingraham *et al.* is for the cylindrical insulator 28 surrounding the conductor 30, which essentially is nothing more than a disclosure of a coated wire.

CONCLUSION

In summary, it is believed that the arguments and amendments set forth above are sound, and accordingly reconsideration of the application is requested along with an early indication of the allowance of claims 1-20 as amended.

Respectfully submitted,

James R. Cartiglia
Registration No. 30,738
Graftech Inc.
Brandywine West
1521 Concord Pike, Suite 301
Wilmington, DE 19803
ATTORNEY FOR APPLICANT

This attorney can be contacted directly at:

James R. Cartiglia
Graftech Inc.
Brandywine West
1521 Concord Pike, Suite 301
Wilmington, DE 19803
Phone 302-778-8207